Mid-Chesapeake Bay Islands Environmental Restoration

Restoration of island habitat through the beneficial use of dredged material: A community approach

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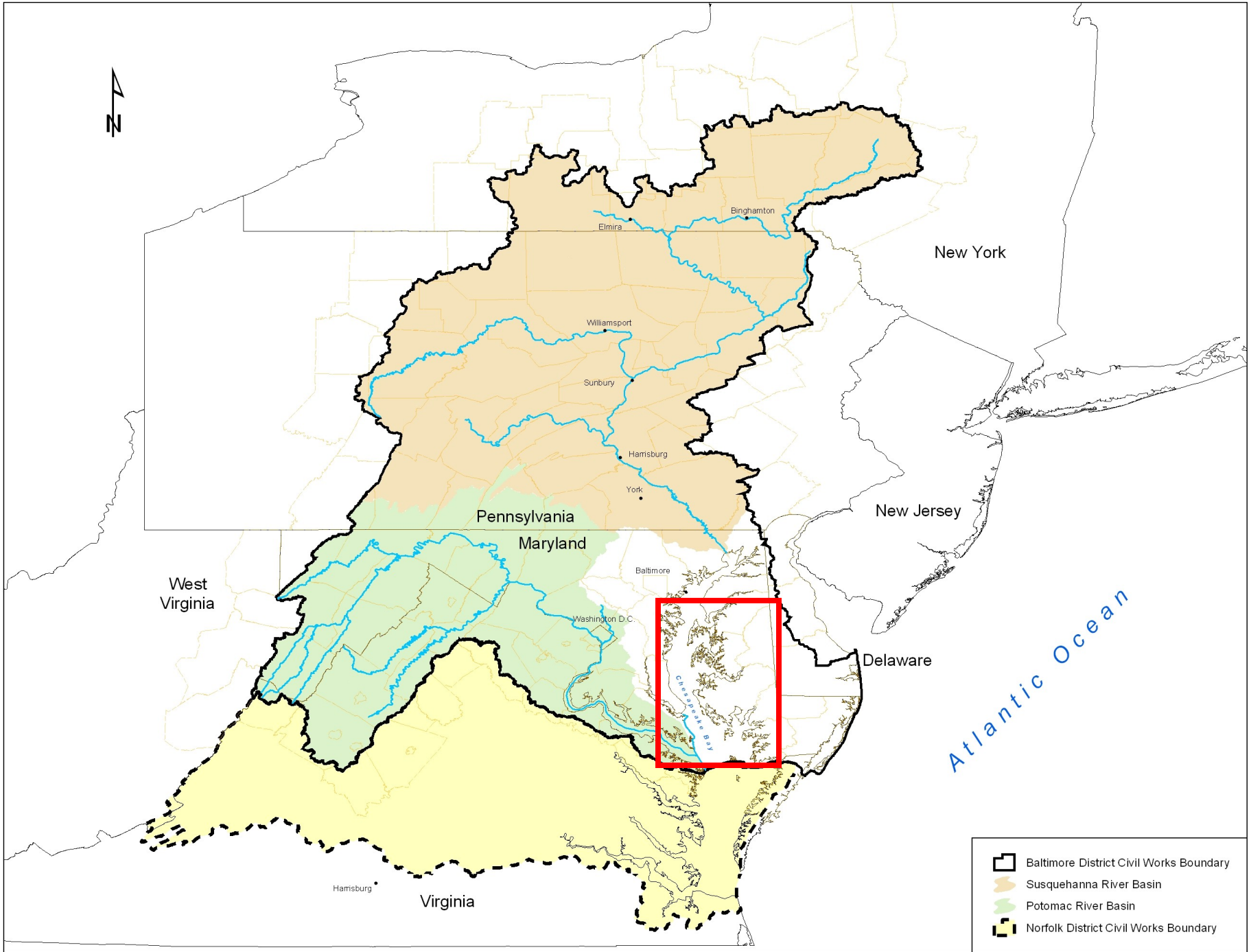
Problems

- Island loss
  - Approximately 10,500 acres have been lost in middle eastern portion of Chesapeake Bay alone.
  - Most islands will be lost in 10-20 years.
  - Remote island habitats preferred by many migratory birds, plus fish and wildlife
- Dredged Material Placement capacity shortfall
  - 4-5 Mcy dredged annually from Port of Baltimore channels
  - Placement sites expected to be full by 2010
  - 34-million cubic yard shortfall in dredge material placement volume over next 20 years


N
Binghamton
Elmira
New York
Williamsport
Sunbury
Harrisburg
York
Pennsylvania
Maryland
New Jersey
West Virginia
Baltimore
Washington D.C.
Delaware
Chesapeake Bay
Atlantic Ocean
Harrisburg
Virginia
Baltimore District Civil Works Boundary
Susquehanna River Basin
Potomac River Basin
Norfolk District Civil Works Boundary

Study Area

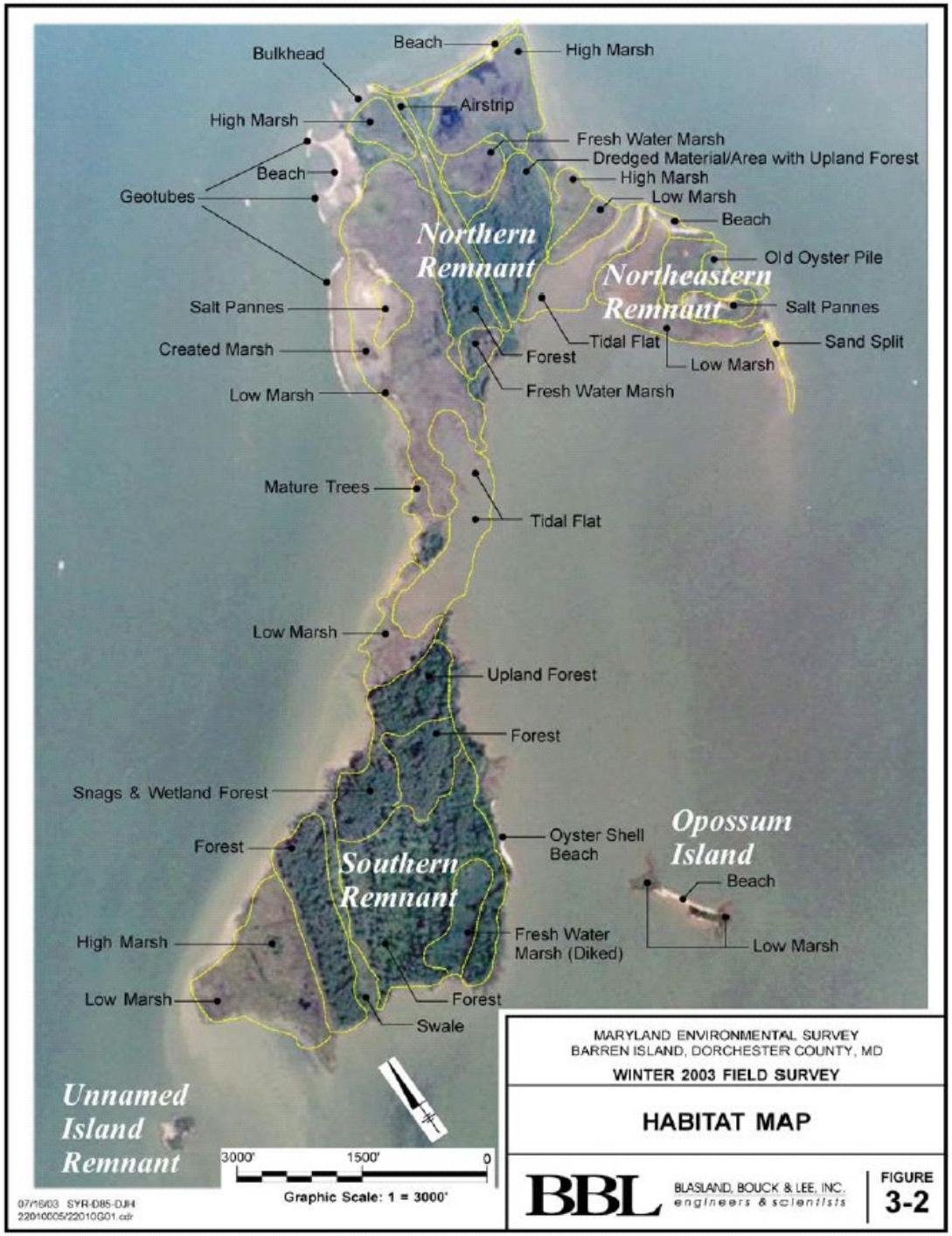
- Concept plans formulated for **James Island and Barren Island**

Project Delivery Team

- Baltimore District
- Philadelphia District
- MD Port Administration
- MD Environmental Services
- MD Department of Natural Resources
- EPA Region III
- EPA Chesapeake Bay Program and Living Resources Subcommittee
- NOAA National Marine Fisheries Service
- NOAA National Ocean Service
- USFWS Chesapeake Bay Field Office
- USFWS Barren Island Wildlife Refuge
- University of Maryland - MEES

Goal

- Restore and protect valuable but threatened Mid-Chesapeake Bay island ecosystems through the beneficial use of dredged material



Existing Conditions Barren Island

year	acreage*
1848	754
1900	539
1930	433
1942	371
1960	260
2004	197

- SAV presence:
  - 1999-2003 average = 695 acres
  - 1994-1998 average = 1.3 acres

Existing Conditions James Island

year	acreage*
1680	1350
1847	978
1900	568
1910	490
1942	336
1960	235
1987	104
2004	79

- SAV presence:
  - 1999-2003 average = 10 acres
  - no beds between 1994-1998

* estimates from sources: State of Maryland, 1949; Kearney and Stevenson,

Alternatives

- Barren- 4 alignments
- James- 5 alignments
- Upland/wetland distributions
  - 100% upland
  - 100% wetland
  - 700 acres uplands/remainder wetlands
  - 70% upland/30% wetland
  - 50% upland/50% wetland
  - 30% upland/70% wetland
- Proposed alignments and combinations produced 170 alternatives

Environmental Benefits

- Workgroup responsibilities:
  - Identify island guilds/communities
  - Identify habitat types
  - Identify the limiting or critical habitat requirements for guilds
  - Assign weights to guilds

Delphi Method

- Panel of experts polled
- Persons included based on their expertise of remote island ecosystems or a specific community
- Included representatives from state and federal resource agencies, private consulting firms, and Corps of Engineers employees (outside the Baltimore District)

Quantification of Environmental Benefits

Island Community Units =

Constructed Island Community Units + Protected Island Community Units

Constructed Island Community Units

- Constructed Island Community Unit, ICU_c =

$$\sum_{g} \left[\left[\sum_{H} (I_{gH} * A_H) \right] * w_g \right]_g$$

where g = guild

H = habitat type

I = Island Community Index value

A = acreage of habitat type

w = guild weight

Habitat Types and Guilds

- Habitat Types (H)
  - upland
  - high marsh
  - low marsh
  - intertidal/mudflat
  - SAV/shallow water
- Communities/Guilds (g)
  - Colonial Nesting Wading Birds
  - Waterfowl
  - Colonial Nesting Waterbirds
  - Raptors
  - Shorebirds
  - Reptile/Herpetofauna
  - Benthic Invertebrates
  - Resident/Forage fish
  - Commercial/Predatory/ Higher Trophic Level fish

Constructed Island Community Index

- Define an Island Community Index (I) for each guild for each habitat type.

  1.0 = optimum/maximum use

  0.75 = use probable, but not optimum

  0.5 = use possible/some habitat value

  0.25 = minimum use

  0 = no use or habitat value

Colonial Nesting Birds (herons, egrets & ibises)

Habitat Type	*Index*	
Upland (as nesting sites)	1	2-10 ha (5-25 ac) including woody vegetation, availability of >250 (820 ft)m buffer for heronries, and freshwater ponds
	0.75	2-10 ha (5-25 ac) including woody vegetation, <250 (820 ft)m buffer, and freshwater ponds
	0.50	<2 ha or 10-100 ha (25-250 ac) with woody vegetation, may or may not include ponds
	0.25	N/A
	0	>100 ha (250 ac), no vegetation or grass (non-woody vegetation)
High Marsh (as foraging habitat)	1	N/A
	0.75	includes intertidal pools
	0.50	N/A
	0.25	> 2 ha, marsh acreage not split 80/20, NO tidal gut or intertidal pools
	0	N/A
Low Marsh (as foraging habitat)	1	>80 ha (200 ac) 80/20 split, upgrade from sand beach, includes tidal gut, plus tidal and intertidal pools
	0.75	>40 ha (100 ac) 80/20 split, includes tidal gut, plus tidal and intertidal pools
	0.50	>20 ha (50 ac) 80/20 split, includes tidal gut, plus tidal and intertidal pools
	0.25	any size, marsh acreage not split 80/20, no tidal guts, no pools, and no sand beach
	0	N/A
Intertidal (as foraging habitat)	1	> 10 ha (25 ac) mudflats and sandy beach/shoreline
	0.75	> 5 ha (12.5 ac) mudflats or sandy beach
	0.50	< 5 ha (12.5 ac) mudflats and/or sandy beach
	0.25	N/A
	0	N/A

Weights Assigned to Guilds (w)

Colonial Nesting Wading Birds (herons, egrets, ibises)	12%
Waterfowl	10%
Colonial Nesting Waterbirds (Gulls, herons, and skimmers)	12%
Raptors	2%
Shorebirds	14%
Birds (total)	*50%*
Reptile/Herpetofauna	*2%*
Benthic Invertebrate	*20%*
Resident/Forage Fish	23%
Commercial/Predatory/Higher Trophic Level Fish	5%
Fish (total)	*28%*
	100%

Habitat Maturity Dates

Wooded upland for Colonial Nesting Wading Birds 25+ yrs

Upland habitat for Colonial Nesting Waterbirds 1 year

Upland for waterfowl use (including woody/shrubby cover surrounding pools for nesting) 10 years

High Marsh (no woody vegetation) 5 years*

High marsh with woody/shrubby vegetation 10 years

Low marsh 5 years*

Intertidal (mudflats) 5 years

Invertebrate communities 10 years

* there will be some additional benefits after 5 years as invertebrate community develops to maturity

- Maturity dates are important because habitat types will have different value (indices) with maturity

N
COACHES ISLAND
JEFFERSON ISLAND
POPLAR HARBOR
POPLAR ISLAND
0
1,000
2,000
3,000
4,000
Feet

1D
1
C
1
B
1
A
Jefferson Island
Poplar
Harbor
Coaches Island
5A
5B
5C
5D
4A
4B
4D
X
3
D
3
C
3
B
3
A
Cell 2
Cell 6
20

Constructed ICU Calculation:
Barren A, 50% wetlands/50% uplands wetland cell in Year 5

Summary of subcell acreage

Multiply Units by weight and then sum to calculate wetland weighted sum by guild.

50% wetlands/50%uplands		Total (ac) = 1354		Island Community Index				Community Units				
		upland = 619										
YEAR 5		wetland= 34.4		upland	high marsh	low marsh	intertidal	upland	high marsh	low marsh	intertidal	
	guild/community	WEIGHT	Sum of Weights	619	6.9	24.8	2.8					Wetland weighted sum by guild
BIRDS	colonial nesting wading birds	12	50		0.75	0.25	0.5		5.16	6.19	1.38	1.53
"	waterfowl	10			0	1	0.5		0	24.77	1.38	2.61
"	colonial nesting waterbirds	12			0.75	1	0		5.16	24.77	0.00	3.59
"	raptors	2			1	0.5	0		6.88	12.38	0.00	0.39
"	shorebirds	14			0.25	0.25	0		1.72	6.19	0.00	1.11
	rept/herps	2	2		1	1	1		6.88	24.77	2.75	0.69
	benthic invert.	20	20		0.5	0.5	0.5		3.44	12.38	1.38	3.44
FISH	resident/forage fish	23	28		0	0.75	0.75		0	18.58	2.06	4.75
"	commercial/predatory/higher	5			0	0.75	0.5		0	18.58	1.38	1.00
	TOTAL	100	100					Constructed Island Community Units				19.10

Wetland acreage distribution

For each habitat, multiply ICI by acreage to get Units

Sum 'weighted sum by guild' totals to calculate Total Constructed Island Community Units

Protected Island Community Units

- Protected (SAV/shallow water) $ICU_{year\ I}$ =

$$\sum_{polygons} (I*A)$$

where A = area of polygon
I = index

- The final protected ICU value equals the average of the annual ICUs.

(SAV = submerged aquatic vegetation = seagrasses)

Protected (SAV) ICI

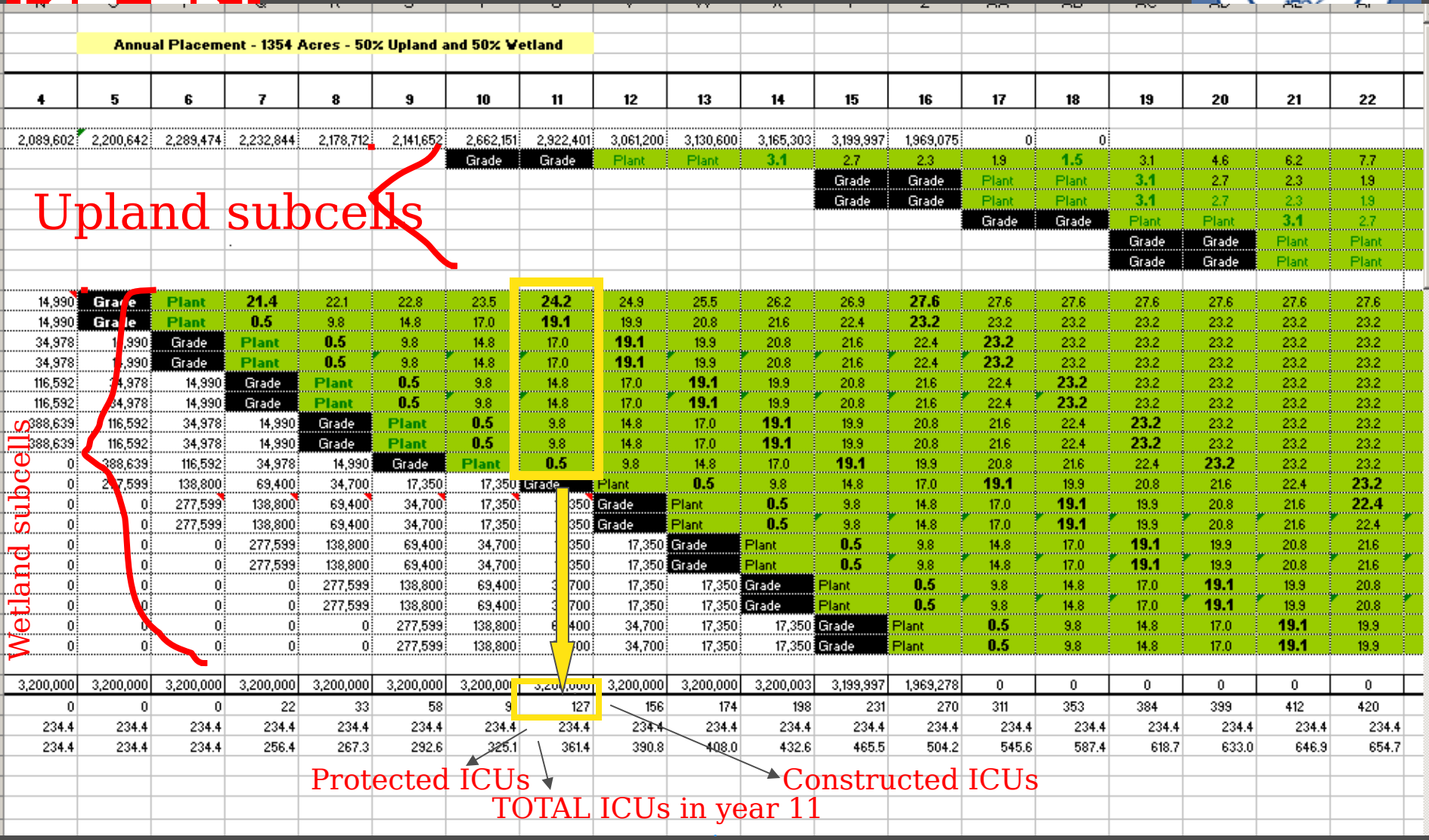
- Obtain SAV maps (source: Virginia Institute of Marine Sciences). Period of record is 1994-2003.

- Assign an index value to each polygon using the identified density:
  - 1.0 = 70-100%
  - 0.75 = 40-70%
  - 0.5 = 10-40%
  - 0.25 = 0-10%
  - 0.0 = no SAV/unmapped

Dredged Material Placement Plan

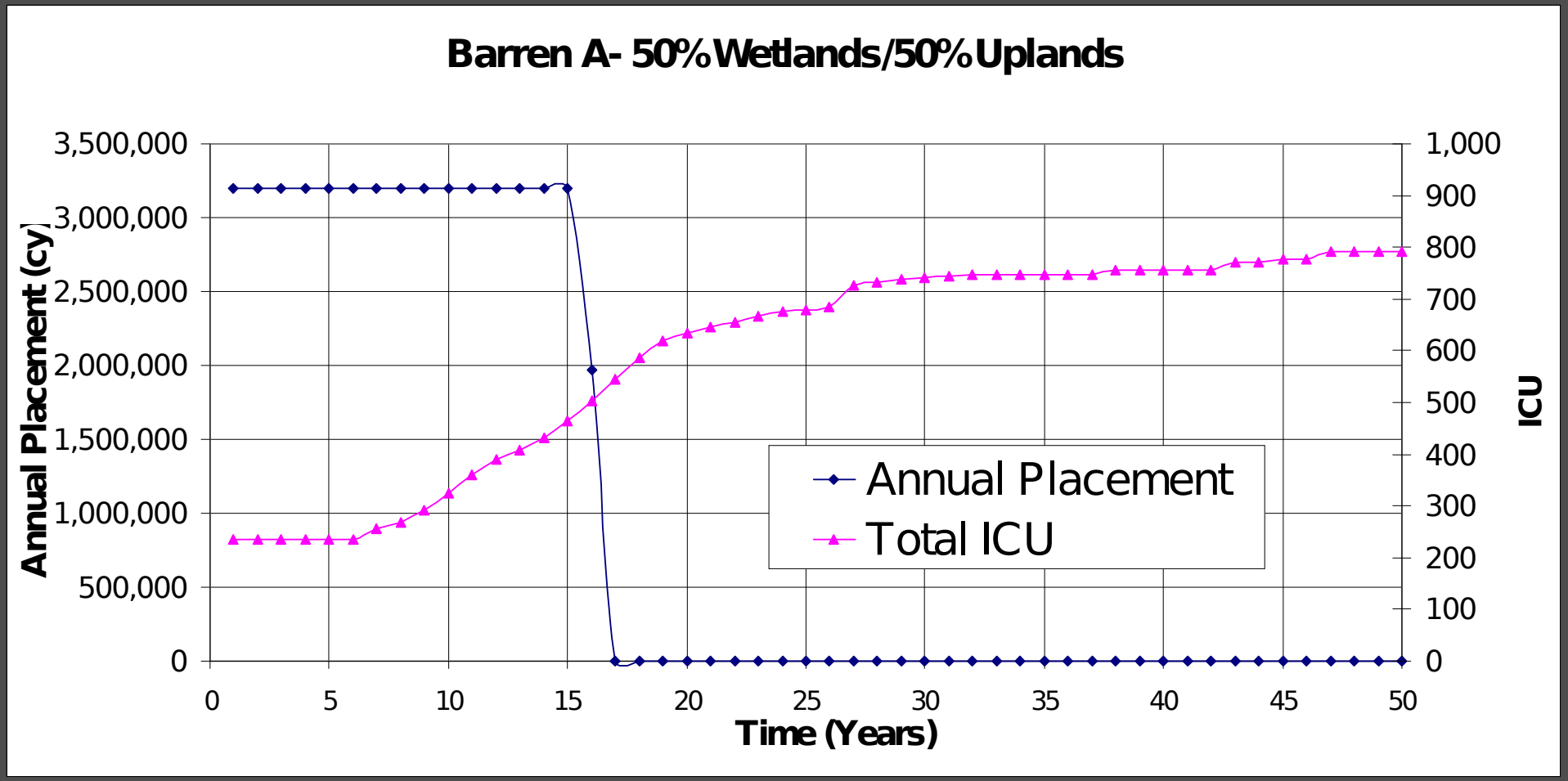
Annual Placement - 1354 Acres - 50% Upland and 50% Wetl

Cell No.	Cell Acreage	Placement Acreage	Volume	Capacity	-2	-1	0	1	2	3	4	5	6	7	8	9	10
Upland	677	619	27,382,847	######				2,422,722	2,189,538	2,119,583	2,089,602	2,200,642	2,283,474	2,232,844	2,178,712	2,141,652	2,662,151
		103															Grade
		103															
		103															
		103															
		103															
		104															
W-1	37.61	34.4	388,639	555,199				388,639	116,592	34,978	14,390	Grade	Plant	21.4	22.1	22.8	23.5
W-2	37.61	34.4	388,639	555,199				388,639	116,592	34,978	14,390	Grade	Plant	0.5	3.8	14.8	17.0
W-3	37.61	34.4	388,639	555,199				0	388,639	116,592	34,978	14,390	Grade	Plant	0.5	3.8	14.8
W-4	37.61	34.4	388,639	555,199				0	388,639	116,592	34,978	14,390	Grade	Plant	0.5	3.8	14.8
W-5	37.61	34.4	388,639	555,199				0	0	388,639	116,592	34,978	14,390	Grade	Plant	0.5	3.8
W-6	37.61	34.4	388,639	555,199				0	0	388,639	116,592	34,978	14,390	Grade	Plant	0.5	3.8
W-7	37.61	34.4	388,639	555,199				0	0	0	388,639	116,592	34,978	14,390	Grade	Plant	0.5
W-8	37.61	34.4	388,639	555,199				0	0	0	388,639	116,592	34,978	14,390	Grade	Plant	0.5
W-9	37.61	34.4	388,639	555,199				0	0	0	0	388,639	116,592	34,978	14,390	Grade	Plant
W-10	37.61	34.4	388,639	555,199				0	0	0	0	277,599	138,800	69,400	34,700	17,350	17,350
W-11	37.61	34.4	388,639	555,199				0	0	0	0	0	277,599	138,800	69,400	34,700	17,350
W-12	37.61	34.4	388,639	555,199				0	0	0	0	0	277,599	138,800	69,400	34,700	17,350
W-13	37.61	34.4	388,639	555,199				0	0	0	0	0	0	277,599	138,800	69,400	34,700
W-14	37.61	34.4	388,639	555,199				0	0	0	0	0	0	277,599	138,800	69,400	34,700
W-15	37.61	34.4	388,639	555,199				0	0	0	0	0	0	0	277,599	138,800	69,400
W-16	37.61	34.4	388,639	555,199				0	0	0	0	0	0	0	277,599	138,800	69,400
W-17	37.61	34.4	388,639	555,199				0	0	0	0	0	0	0	0	277,599	138,800
W-18	37.61	34.4	388,639	555,199				0	0	0	0	0	0	0	0	277,599	138,800
Total	1,354			######				3,200,000	3,200,000	3,200,000	3,200,000	3,200,000	3,200,000	3,200,000	3,200,000	3,200,000	3,200,000
constructed ICU					0	0	0	0	0	0	0	0	0	22	33	58	31
protected (SAV) ICU					234.4	234.4	234.4	234.4	234.4	234.4	234.4	234.4	234.4	234.4	234.4	234.4	234.4
Total (Constructed and protected) ICU					234.4	234.4	234.4	234.4	234.4	234.4	234.4	234.4	234.4	256.4	267.3	292.6	325.1


Annual Placement - 1354 Acres - 50% Upland and 50% Wetland
Upland subcells
Wetland subcells
Protected ICUs
TOTAL ICUs in year 11
Constructed ICUs

Placement and Habitat Development for Project Life

This picture is too small to read, but is included to show placement and habitat development plan for the entire p full environmental benefits are achieved in year 50.


Barren A- 50%Wetlands/50%Uplands
Annual Placement (cy)
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
1,000
900
800
700
600
500
400
300
200
100
0
ICU
0
5
10
15
20
25
30
35
40
45
50
Time (Years)
Annual Placement
Total ICU

Acknowledgements

- Project Delivery Team
- Plan Formulation Workgroup

THANK YOU

QUESTIONS???

Extra Slides Follow

Table 2: Island Screening Criteria

Criteria	Description	Ranking	Weighted Factor
Possible restoration size (acres)	<300	0	2
	300-700	2	
	700-1000	4	
	1000-2000	5	
Possible capacity (mcy)	<10	0	4
	11-20	1	
	21-30	2	
	31-40	3	
	41-50	4	
	>50	5	
Foundation material	Soft silt/clay	0	2
	Medium silt/sand	3	
	Stiff lay or silty sand	4	
	Sand	5	
Borrow material found on site (should be sand)	Clay or silt	0	2
	Covered sand	3	
	Sand	5	
Depth of site range (should be 8-10 ft)	<5	0	2
	5-8	2	
	8-10	5	
	10-12	2	
	>12	0	
Length of access channel (mi)	<0.5	5	2
	0.5-1	3	
	1-2	1	
	>2	0	
Mean Tidal Range (ft)	<1	0	1
	1-1.5	3	
	>1.5	5	
Stone size (lbs)	<1500	5	1
	1500-3000	3	
	>3000	1	
Hauling Distance (mi)	<30	5	3
	31-40	4	
	41-60	3	
	61-70	2	
	>70	0	
Possibility of finding UXO's	Yes	0	1
	Potential	3	
	No	5	

Ranking of Islands

James (77)

Barren (74)

Hooper (49)

Ragged (49)

Holland (47)

Smith (45)

South Marsh (39)

Little Deal (29)

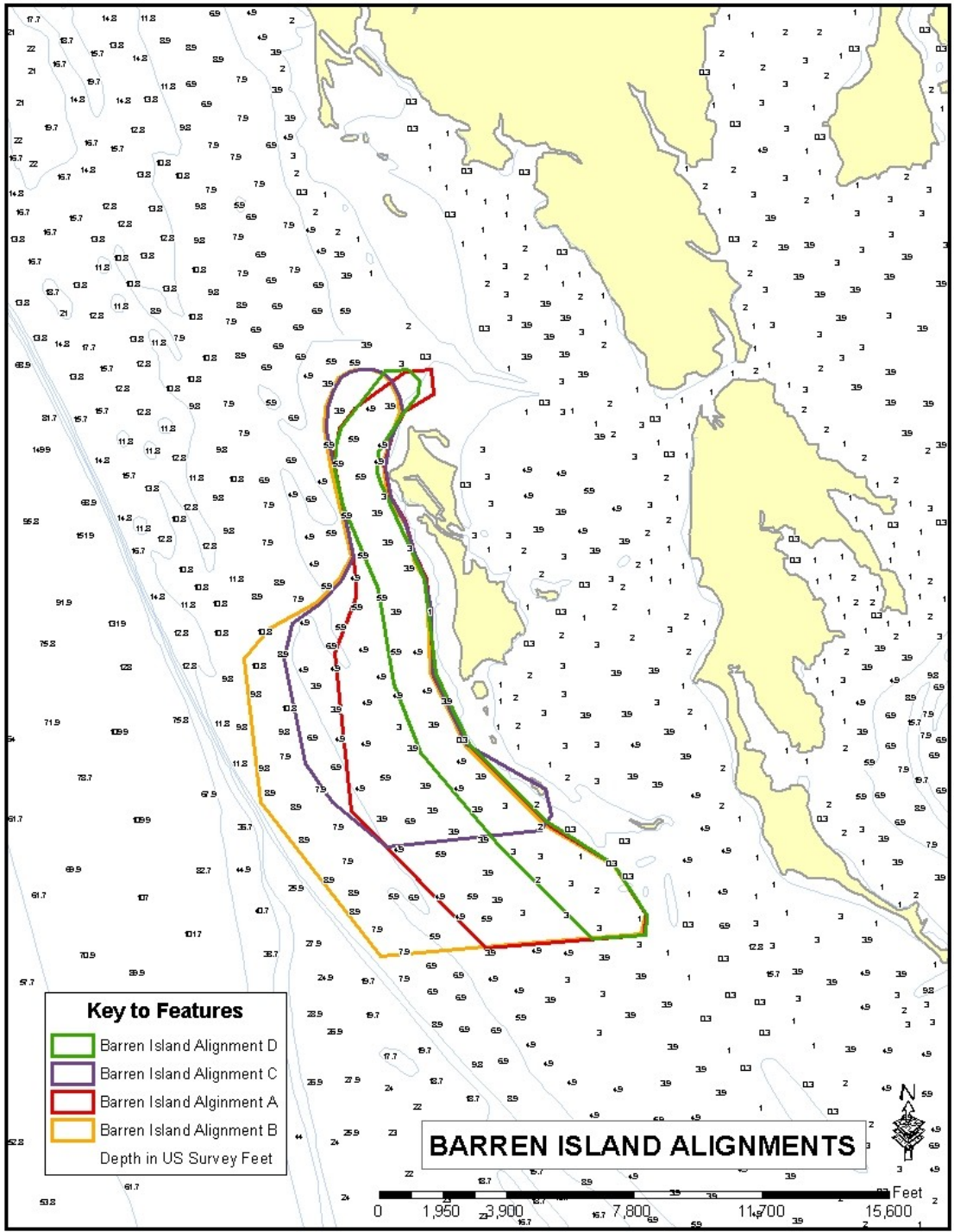
Environmental Suitability Criteria

- Workgroup established to determine environmental benefits
  - identify habitat types and communities to target
  - identify the limiting habitat requirements for communities based on the species that compose those communities
  - determine benefits each community will receive from each habitat type
  - assign weights to habitat types
- Needed discrete numbers to following considerations:
  - size of islands/hummocks
  - size of upland and wetlands
  - amount of tidal gut or open water
  - distance needed to provide ‘isolated’ interior islands
- Used Adelphi (consensus) Method to solicit experts for information

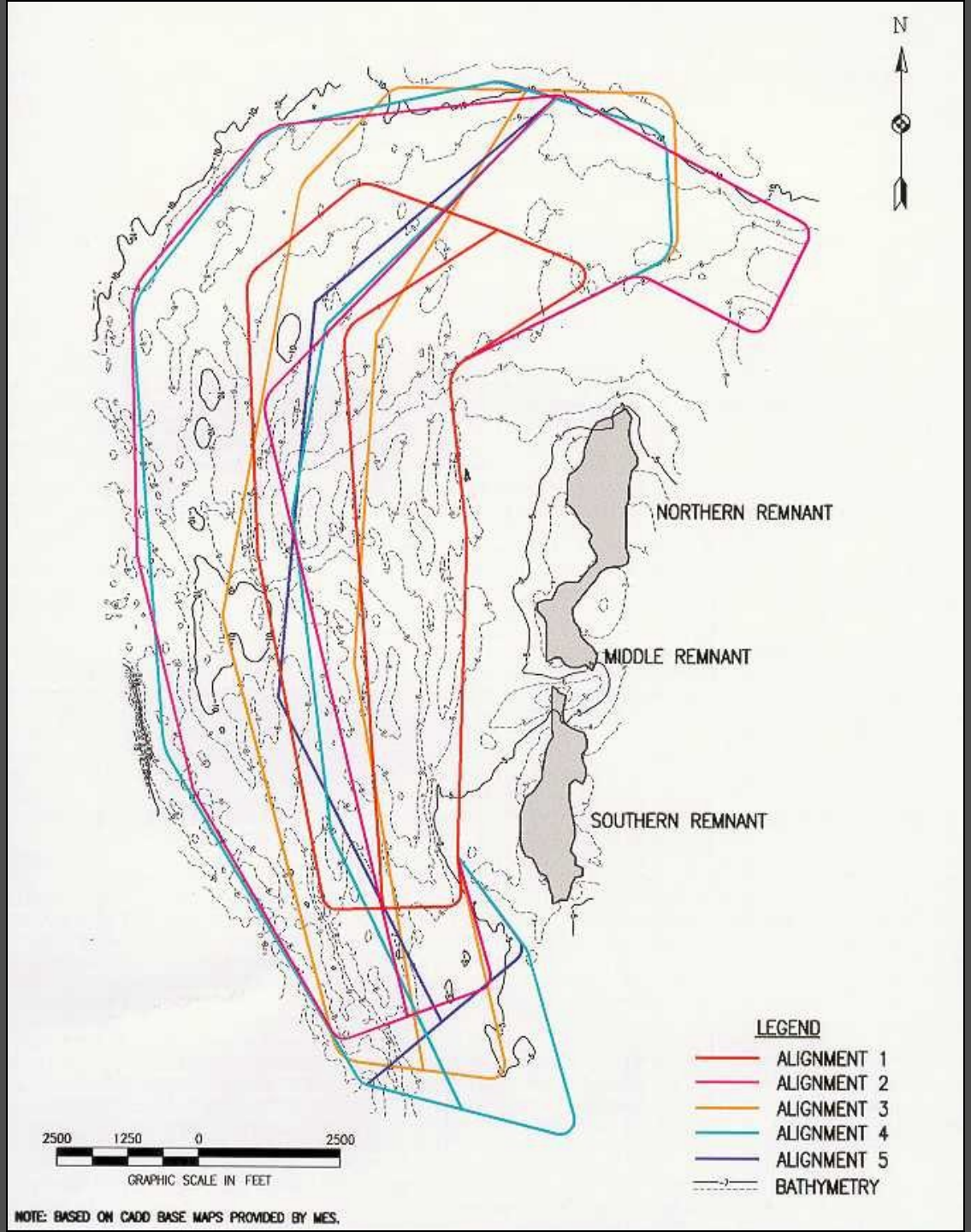
Constraints

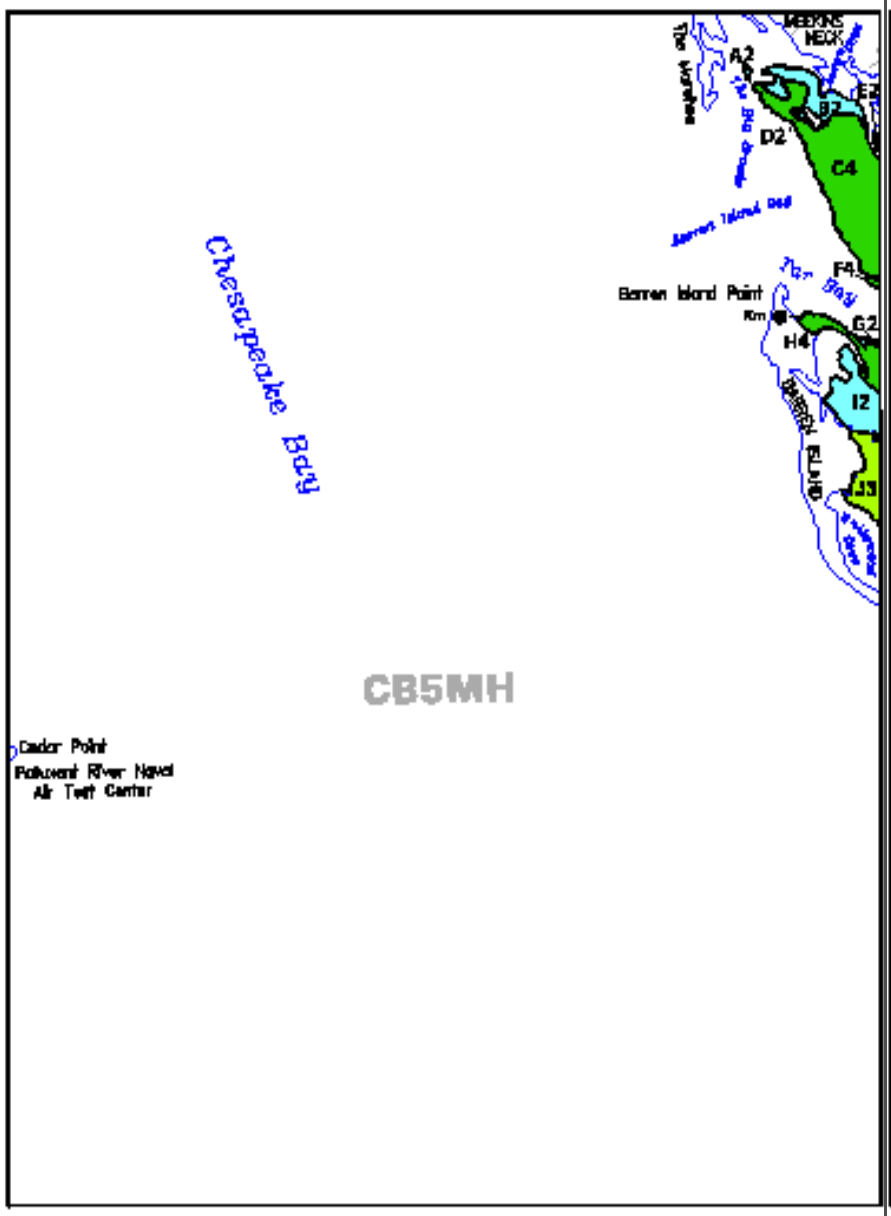
- Provide for placement of 3.2 M yd^3/yr
- Efficient placement of material (80% in uplands/20% in wetlands)
- Resource Agency preferences (at least 50% wetlands)
- Footprint of project- Barren restricted to 1000 acres, James to 2000 acres
- Minimum of 20 ft uplands (25 ft dikes)
- No wetlands within sand borrow areas
- Sufficient material on-site to create dikes

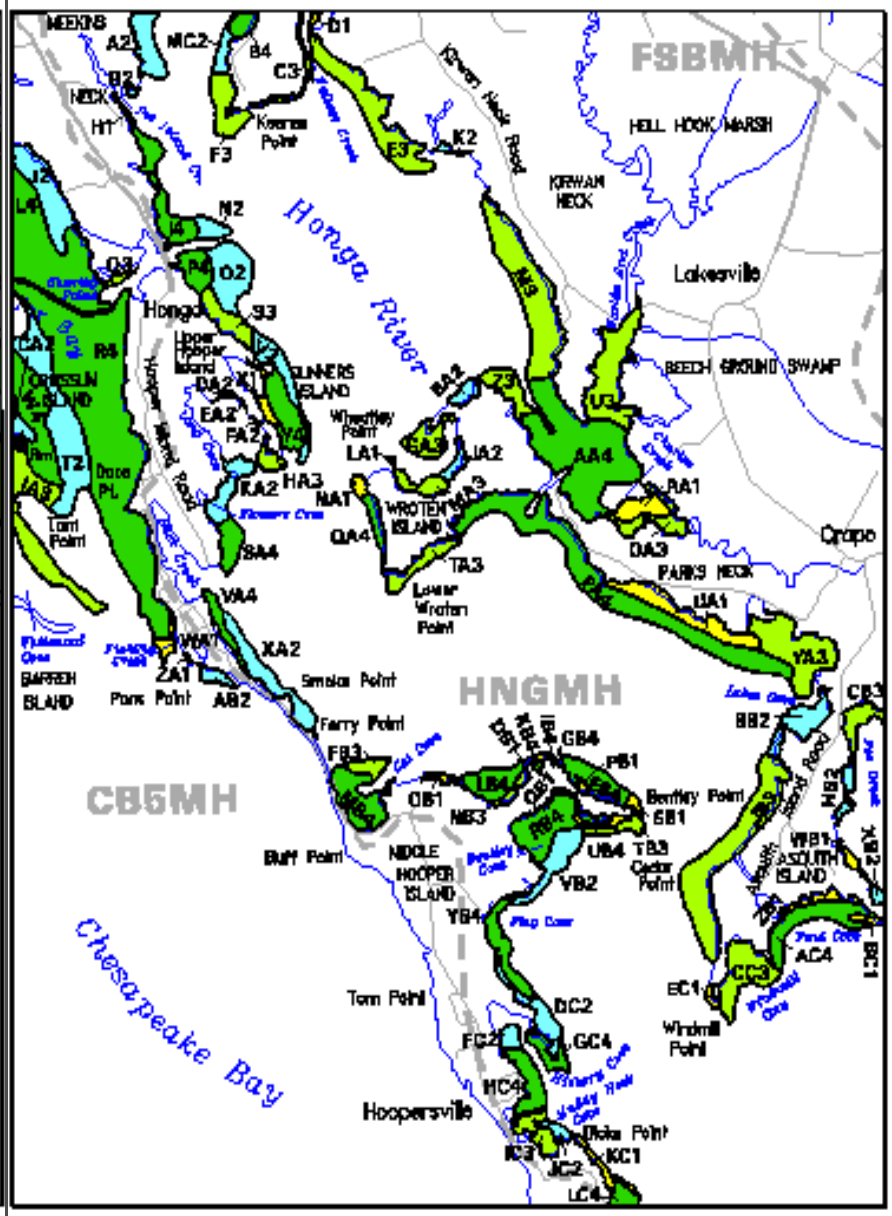
Potential Barren Island Alignments



Potential James Island Alignments




Chesapeake Bay
CB5MH
Barren Island Point
Cedar Point
Patuxent River Naval
Air Test Center
Hectares of SAV: 262.85
Date Flown: 06/04, 08/02, 10/04, 10/05
1000 0 1000 2000 meters
2001 SAV Density Class
0-10%
10-40%
40-70%
70-100%
Sources: VIMS,USGS


FSBMH
HNGMH
CB5MH
Honga River
Chesapeake Bay
Lakesville
Oriole
Hoopersville
Tom Point
Buff Point
Ferry Point
Barren Island
Hooper Island
Bentley Point
Cedar Point
Windmill Point
Dicks Point
Hectares of SAV: 1,838.17
Date Flown: 06/04, 10/04, 10/05
1000 0 1000 2000 meters
2001 SAV Density Class
0-10%
10-40%
40-70%
70-100%
Sources: VIMS,USGS

Quantification of Environmental Benefits

1. Choose an alignment and a upland/wetland ratio.
2. Identify cell size from dredged material placement plan. There will be separate upland cells and wetland cells.
3. Assign an ICI for each habitat type planned for cell for year 1.
4. Calculate Total Constructed ICU for cell for year 1 and insert into placement plan.
4. Repeat Steps 2, 3, and 4 for year 5, 10, and 25.
5. Repeat Steps 1-4 for all alignments and upland/wetland ratios.

Dredged Material Management Plan (DMMP)

- Baltimore District and MPA (Maryland Port Administration) are conducting DMMP for the Port of Baltimore.
- DMMP will develop a long-term strategy for providing viable placement alternatives while maximizing beneficial use

- Large island restoration is one alternative being considered by DMMP

Objectives

- *Flexible, measurable, attainable, and congruent*
  1. Restore and enhance marsh, aquatic, and terrestrial island habitat for fish, reptiles, amphibians, birds, and mammals;
  2. Protect existing island ecosystems, including sheltered embayments;
  3. Minimize impacts to existing fisheries nursery, feeding, and protective habitats;
  4. Increase wetlands acreage in the Chesapeake Bay watershed;
  5. Decrease local erosion and turbidity;

Objectives, con’t.

6 Promote conditions to establish and enhance submerged aquatic vegetation;

7 Promote conditions that support oyster recolonization;

8 Minimize impacts to rare, threatened, and endangered species and their habitat;

9 Minimize impacts to existing commercial fisheries;

10 Minimize establishment of invasive species to maximum extent possible;

11 Optimize the capacity for placement of dredged material (3.2 mcy/yr).

Results of Delphi Method

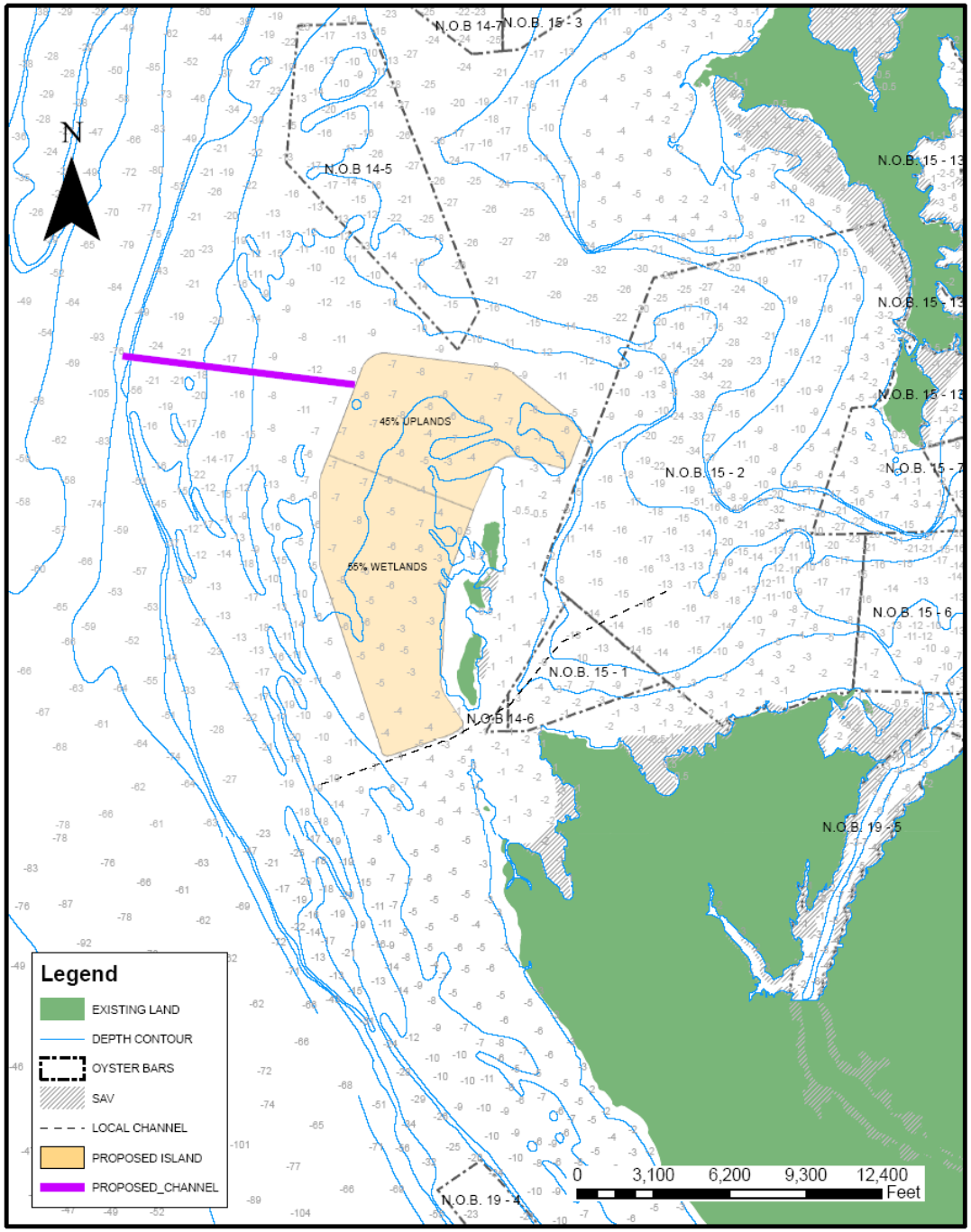
Birds		
Colonial Nesting Birds	2-10 hectares (5-25 acres)	upland/high marsh mix with majority uplands
feeding waterfowl, shorebird	> 3 ha (7.4 acres)	open water or unvegetated tidal flats
The ratio of low marsh/high marsh = 80/20		
Reptiles/Amphibians		
nesting turtles	well-drained soil (including piles of woody debris), usually open, non- or sparsely vegetated	
	e.g.- (NJ) Diamondbacks- vegetated dunes facing away from the sea, relatively flat, in areas with <20% vegetative	
	More is better	
Benthic Invertebrates	Ubiquitous	
Fish	East side- broad sloping sandy beaches that grade into low marsh	
	-beaches should be cut periodically with channels which go into low marsh	
	West side- armored with curving or undulating riprap to provide both shallow and deep water habitat	
	-narrow periodic rock jetties extending westward	
Oysters	water depth	< 20 ft (due to anoxia)
	DO	can withstand 0 ppm for short periods (T dependent)
	Temperature	none in Chesapeake Bay
	salinity	> 2 ppt, optimum = 15 ppt
	sedimentation rate	< oyster growth rate
SAV	sediments	< 5% organic matter (0.4-5%)
		grain size = 0.4-30% fines (<64 um)
	water movement	minimum velocities = 3-16 cm/s
		maximum velocities = 50-180 cm/s
	wave tolerance	0-1 m = limited growth (canopy formers)
		>2 m = tolerant growth (meadow formers)
	water clarity	growing season Secchi depth > 1.9 m
	(application depths for the new water clarity goal for both islands are 2 m)	
	Percent light through water (PLW)	22%
	Median Kd (light attenuation)	0.76/m

Recommended Plan

- Cost effective incremental analysis using environmental benefits and project costs determined 'Best Buys'

Alternative	Total Cost ($000s)	Total ICUs	Ave Cost $/ICU	Dredged Material Capacity (Mcy)
No Action	$0	6,427	$0	0
James 3, 50/50	$724,074	19,396	$22,083	58.5
James 3, 45/55	$727,904	20,492	$21,012	62.5
James 3, 40/60	$726,977	20,931	$20,545	64.8
James 5, 50/50	$941,842	22,626	$24,624	76.5
James 5, 45/55	$955,068	24,598	$22,968	71.9
James 5, 40/60	$962,079	25,797	$22,061	84.7
Barren A, 50,50	$686,946	32,467	$12,533	50
Barren A, 45,55	$697,615	33,385	$12,345	53.3
5D, 50/50	$1,252,759	44,234	$16,753	101.7
J5+Bp, 50/50	$956,842	38,686	$14,731	76.5
5D, 45/55	$1,281,376	45,641	$16,608	91.9
5D, 40/60	$1,279,677	46,861	$16,154	97.6
J5+Bp, 45/55	$970,068	40,650	$14,212	71.9
J5+Bp, 40/60	$977,079	41,850	$13,903	84.7

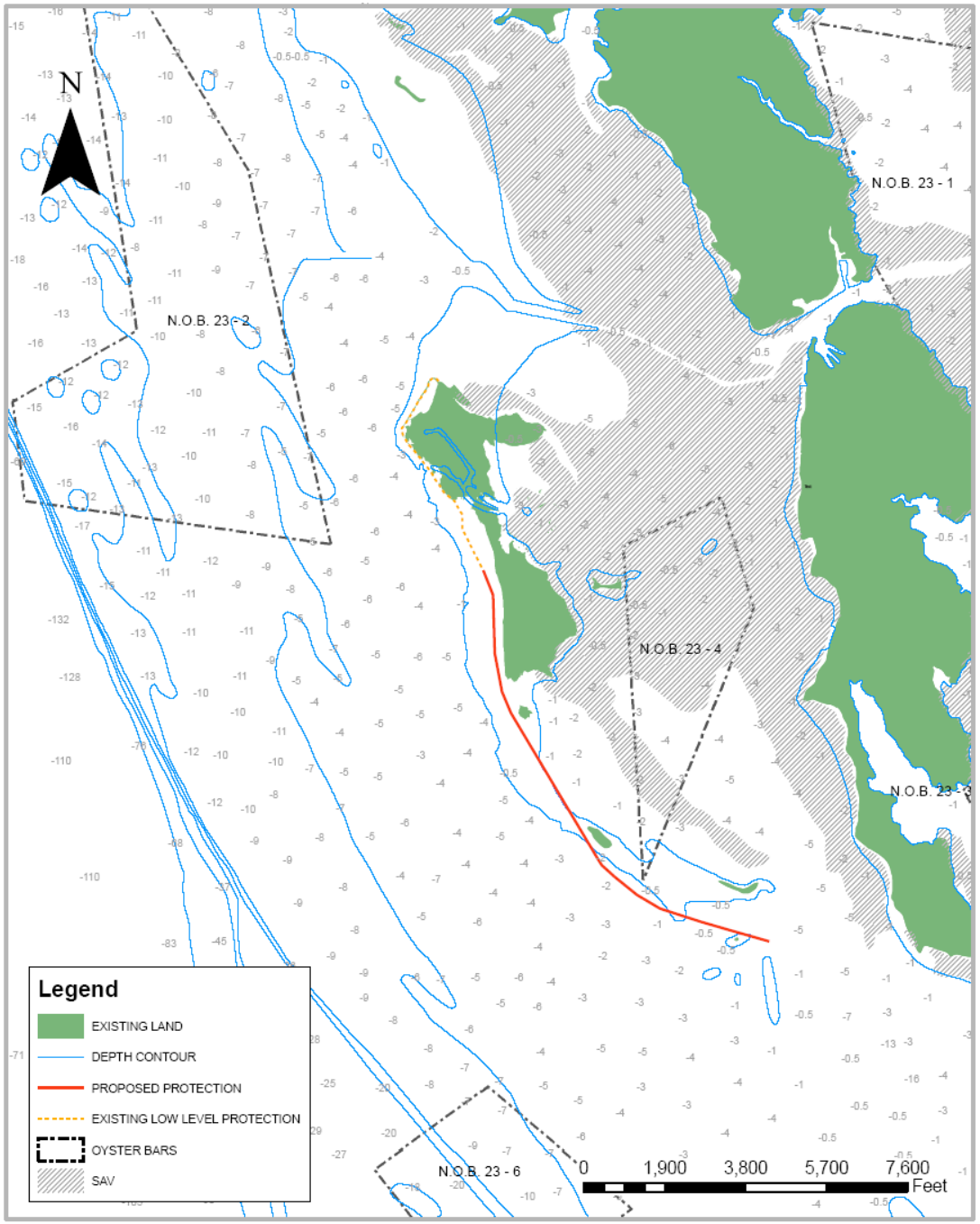
- Objectives



JAMES ISLAND - REVISED PLAN
NOVEMBER 2004

James Island

- creation of 2072 acre island, 45% uplands and 55% wetlands, 20 ft uplands



BARREN ISLAND - CONCEPT PROTECTION PLAN
NOVEMBER 2004

Barren Island

- protection and restoration of existing resources